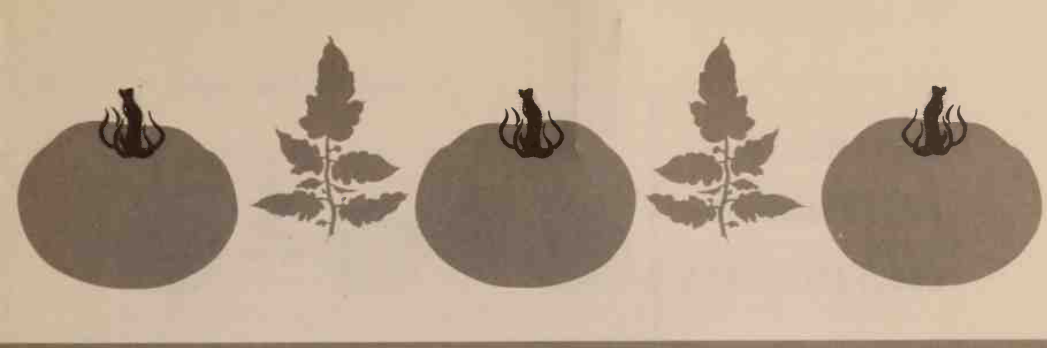
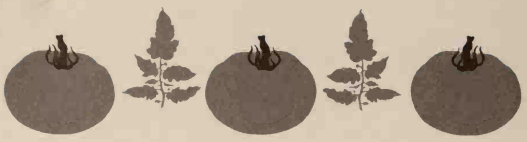


CONTROLLING *tomato diseases*

U.S. DEPARTMENT OF AGRICULTURE • FARMERS' BULLETIN NO. 2200

CONTROLLING *tomato diseases*



Information for this publication was furnished by the Plant Genetics and Germplasm Institute, Agricultural Research Service.

Some diseases that commonly affect tomatoes are fusarium wilt, verticillium wilt, damping-off, septoria leaf spot, gray leaf spot, early blight, late blight, bacterial spot, anthracnose, soil rot, root knot and tobacco (tomato) mosaic.

Other disorders that commonly affect tomatoes are blossom-end rot, catface, and 2,4-D injury.

Following are ways in which you can prevent or reduce losses from disease:

- Plant resistant varieties if they are available.
- Treat seed with a fungicide.
- Apply fungicides to foliage and fruit.
- Rotate crops.
- Fumigate the soil.

DISEASES

Fusarium Wilt

Fusarium wilt attacks tomato plants in many regions of the United States. The first symptom of this disease is yellowing of the lower leaves. The yellowed leaves gradually wilt and die. As the disease progresses, yellowing and wilting continue up the stem until the foliage is killed and the plant dies (fig. 1). The stem shows no soft decay, but the woody tissue under the outer (green) stem turns dark brown.

Control.–Plant resistant varieties (see p. 9).

Verticillium Wilt

Verticillium wilt causes serious losses of tomato plants in some sections of California and Utah. Since 1959 losses have been severe in some North Central and Northeastern States. This disease is rare in the South, except in the Homestead area of Florida.

First symptoms appear on leaves at the bottom of the plant. These leaves turn yellow, gradually wither, and fall. Leaves higher on the stem become dull in color, and leaflets may curl upward. As the disease progresses in the plant, only leaves near the tips of branches remain alive. All branches may be affected and they are less erect than branches on healthy plants.

Control.–Plant resistant varieties (see p. 9).

Damping-Off

Damping-off is a soilborne disease that is distributed throughout the United States. It causes decay of seed or seedlings in the soil, or causes young plants to collapse and die (fig. 2).

Control.–Treat seed with thiram or dichlone.

Septoria Leaf Spot

Septoria leaf spot is most prevalent in the Middle Atlantic and North Central States, and frequently occurs as far south as Arkansas and South Carolina. It is of minor importance in the Deep South, the Mountain States, and the Pacific States.

Septoria leaf spot is one of the most destructive leaf diseases of tomato plants. It occasionally attacks the stems and blossoms, but rarely attacks the fruits. Infection usually occurs on the lower leaves of tomato plants after they begin to set fruit, but it may occur on young plants.

Infected leaves develop water-soaked spots. The spots are circular; they have gray centers and blackish borders. Tiny dark specks develop in the centers of the spots (fig. 3). If spotting is severe, the leaves eventually die and fall, and fruits are subject to sunscald.

Control.–Destroy plant refuse or bury it deeply during land preparation. Rotate crops. Control weeds. Maneb or zineb may be used as a chemical control.

Gray Leaf Spot

Gray leaf spot is most prevalent in the Southern States. This disease does not infect the fruits of tomato plants.

Infected leaves develop small dark-brown spots (fig. 4) that extend through to the undersides of the leaves. These spots enlarge, turn grayish brown, and become glazed. As the disease spreads,

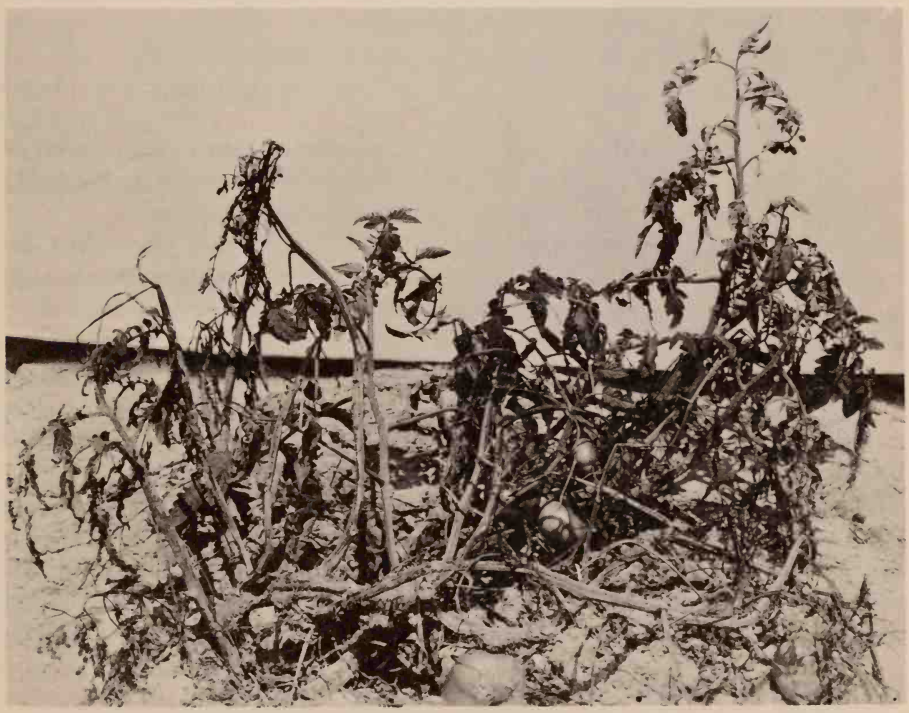


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Figure 1.–Tomato plant showing symptoms of fusarium wilt.

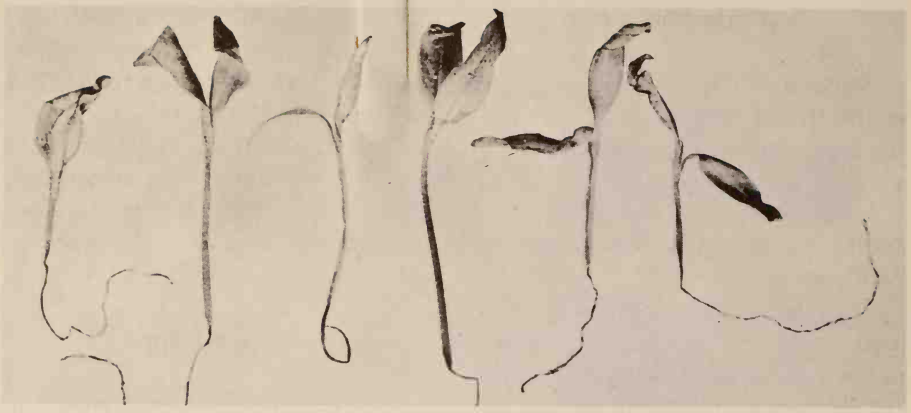

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Figure 2.—Tomato seedlings affected with damping-off.

leaves turn yellow, wither, and fall. In warm, moist weather, gray leaf spot may kill all leaves except those near the tips of branches.

Control.—Plant resistant varieties (see p. 9). Captafol, chlorothalonil, maneb, or zineb may be used as a chemical control.

Early Blight

Early blight occurs to some extent in most tomato-growing regions. It is most common and serious in the New England, Atlantic, and Central States. This disease occurs on the stems, leaves, and fruits of tomato plants.

Infected stems develop dark-brown cankers that may girdle plants at the soil line. Infected leaves show small, irregular, dark-brown spots, which often enlarge into circular spots that have target-like markings (fig. 5). The leaf tissues surrounding these spots usually turn yellow.

Dark, leathery, decayed spots appear on the stem end of fruits infected with early blight. These spots (fig. 6) enlarge and develop target-like markings. The decay extends deep into the flesh of the fruit.

Control.—Plant resistant varieties (see p. 9). Captafol, chlorothalonil, maneb, or zineb may be used as a chemical control.

Late Blight

Late blight occurs in humid areas of the United States. It affects the leaves and fruits of tomato plants.

Leaves of infected plants first develop greenish-black, water-soaked blotches (fig. 7). The blotches enlarge rapidly. In moist weather a white, fuzzy growth develops on the undersides of the leaves, and infection spreads rapidly to nearly all the leaves. The plants eventually wither and die.

Fruits of infected plants first develop a grayish-green, water-soaked spot. The spot becomes brown and wrinkled, and often covers half of the fruit (fig. 8). The border of the spot usually is slightly sunken. The infected tissue may develop a white fungus growth in moist weather.

Control.—Plant resistant varieties (see p. 9). Maneb, zineb, chlorothalonil,

fixed copper, or Captafol may be used as a chemical control.

Bacterial Spot

Bacterial spot most frequently occurs in the Southern, Central, and Middle Atlantic States. It is most prevalent during warm, rainy seasons. Bacterial spot affects the leaves, stems, and green fruits of tomato plants.

Infected leaves first show small, irregular, dark-green spots, which have a greasy appearance. The spotted tissues turn brownish black, eventually dry out, and frequently tear. Spotted leaves—even those having only a few spots—turn yellow and eventually fall.

Green tomatoes that are infected with bacterial spot first show tiny water-soaked spots. The spots enlarge, develop greenish-white borders, and become slightly raised (fig. 9). They eventually turn light brown and become sunken and scabby. Fruit are not infected after they ripen.

Control.—Fixed copper may be used as a chemical control.

Anthracnose

Anthracnose is a common and widely distributed rot of ripe tomatoes. It does not cause serious losses where tomatoes are harvested green.

Infected tomatoes first show small water-soaked spots that are slightly sunken. The spots enlarge, darken, become more sunken, and often develop targetlike markings (fig. 10). The centers of the spots may turn tan and develop dark specks.

Control.—Captafol, chlorothalonil, maneb, or zineb may be used as a chemical control.

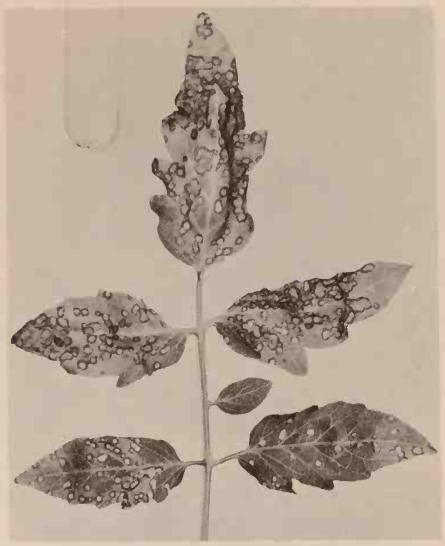

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Figure 3.—Tomato leaves showing symptoms of septoria leaf spot. Spots have dark borders and light centers with dark specks.

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Figure 4.—Tomato leaf showing symptoms of gray leaf spot. Spots are small and irregularly shaped, and have a grayish-brown glazed appearance.

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Figure 5.—Tomato leaves showing symptoms of early blight. Note targetlike markings.

BN-25870

Figure 6.—Tomato affected with early blight.

BN-25871

Figure 7.—Tomato leaves showing dark blotches characteristic of late blight.

Soil Rot

Soil rot frequently occurs when tomatoes are allowed to lie on the soil and when rain repeatedly splashes soil on them.

Infected tomatoes first develop a brown targetlike spot that is slightly sunken. The spot enlarges; its center becomes dark brown and frequently breaks open (fig. 11).

Control.—Grow tomatoes on well-drained soil. Stake or mulch tomato plants to prevent fruit from touching the ground.

Blossom-End Rot

Blossom-end rot, a physiological disorder, occurs to some extent wherever tomatoes are grown. A small water-soaked spot first develops at or near the stem end of infected tomatoes. The spot (fig. 12) enlarges and darkens; it becomes sunken and leathery.

Blossom-end rot is most prevalent during prolonged dry periods that occur while the plants are making vigorous growth. It may also occur after periods of unusually abundant rain. Heavy applications of nitrogen fertilizers and extreme fluctuations in moisture favor the disease.

Control.—Apply proper amounts of lime and superphosphate. Avoid excessive use of nitrogen fertilizers. Maintain an even supply of moisture for the plants through timely and thorough irrigation.

Catface

Catface occurs to some extent wherever tomatoes are grown. It affects the fruits. Affected fruits are malformed; they have cellular indentations (fig. 13) on their stem end.

The cause of catface is not fully understood, but some varieties of tomatoes are more subject to catface than others.

Control.—Grow locally recommended varieties.

2,4-D Injury

Tomatoes are very susceptible to injury by 2,4-D. Leaves of tomato plants that are injured by 2,4-D (a herbicide) first curl downward. If the injury is severe, the leaves eventually roll and new growth is twisted (fig 14). The main stem may split; small shoots may develop along the opening.

Control.—Use low-volatile ester or amine salt formulations of 2,4-D for weed control in nearby fields. Avoid spraying on windy days. Use separate sprayers for herbicides, fungicides, and insecticides.

Tobacco (Tomato) Mosaic

Tobacco, or tomato, mosaic is common throughout the United States. It causes a yellow-green mottling on leaves and occasionally on fruit. Infected leaves are curled and slightly malformed (fig. 15). Plants are stunted and fruit yields are reduced.

This disease is highly infectious. It is spread mainly by persons who handle plants.

Control.—No control, except sanitation. Avoid excessive handling of tomato seedlings. If you smoke, wash hands with soap and water before touching tomato plants; do not smoke while working with tomato plants.

Root Knot

Root-knot is caused by a nematode. The wormlike nematode larvae hatch

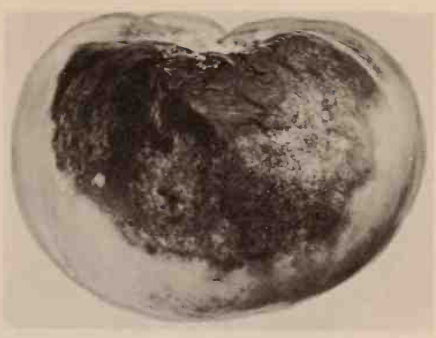

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Figure 8.—Green tomato affected with late blight. Note wrinkled tissue.

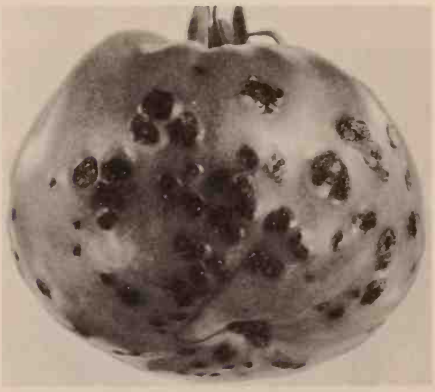

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Figure 9.—Tomato showing a late stage of bacterial spot. The spots are raised, but the centers are slightly sunken and have a rough, scabby appearance.

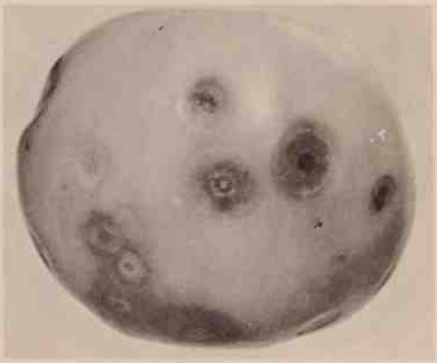

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Figure 10.—Tomato showing symptoms of anthracnose. Spots are sunken and have targetlike markings.

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Figure 11.—Tomato showing symptoms of soil rot. Note broken tissue and targetlike markings.

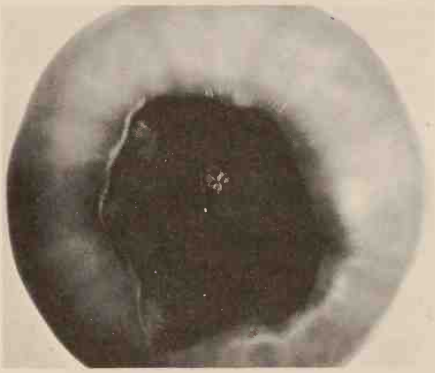

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Figure 12.—Tomato showing symptoms of blossom-end rot. Spot is dark, sunken, and leathery.

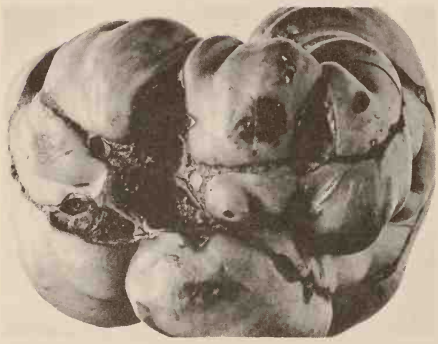

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Figure 13.—Tomato showing symptoms of catface. Note cellular indentation and malformation of tomato.

from eggs in soil or on roots and enter the roots where they feed. The feeding causes enlargements (root-knots or galls) which vary from 1/16 inch to 3/4 inch in diameter (fig. 16). Nematode damage makes tomato plants susceptible to and increases the severity of other diseases, especially fusarium wilt and bacterial wilt.

Severe infestations can reduce yield up to 80 percent. Infected plants are stunted, have chlorotic (yellow) foliage, and wilt easily. Root-knot nematode damage is most severe in sandy soils.

Control.—Plant resistant varieties. Use only disease-free transplants or seed directly. Do not plant in soil where infected crops have been grown within the past two seasons. If the soil is known to be infested with nematodes, treat it with a nematicide or a general-purpose soil fumigant.

Bacterial Wilt

Bacterial wilt is caused by bacteria that live in soil. The disease is most serious on moist soils when temperatures are above 75° F. The disease is endemic in the Southern States, but occurs sporadically in other parts of the country.

The symptoms are rather rapid wilting and death of the entire plant unaccompanied by any yellowing or spotting of the leaves (fig. 17). If the stem of a wilted plant is cut across near the ground, the pith has a darkened, water-soaked appearance. There will also be a grayish, slimy exudate when the stem is pressed. In later stages of the diseases, decay of the pith may cause extensive hollowing of the stem. These symptoms differ from those of fusarium and verticillium wilts, which do not cause sudden wilting or decay of the stems of

older plants. Bacterial wilt causes no spotting of the fruits.

Control.–Plant resistant varieties (see following section). Practice crop rotation. Because the bacteria can cause injury to other crops such as peppers, tobacco, potatoes, and eggplant, do not plant tomatoes in fields where these crops have shown symptoms of bacterial wilt in the previous 4 years.

CONTROL MEASURES

Planting Resistant Varieties

The planting of disease-resistant varieties is the most effective way to control some tomato diseases. The list of resistant varieties which follows includes many commonly grown for processing or fresh market. Varieties suitable for machine harvest are marked with an asterisk (*).

Fusarium (Race 1) Wilt

Campbell 28*	Marion
Chico III*	Nemared
Dorchester*	Roma
Floradel	Saturn
Homestead	Venus
Manalucie	West Virginia 63
Manapal	

Fusarium (Races 1 and 2) Wilt

Florida MH-1*	Walter

Fusarium (Race 1) and Verticillium Wilts

Beefeater VFN	Ramapo
Better Boy	Red Rock*
Calmart*	Supersonic
Heinz 1350	Tropic
Merit*	VF 145 strains*
Jet Star	VFN Bush*
Pakmor*	

Early Blight

Floradel	Manalucie

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Figure 14.–Tomato leaf showing downward curling that is characteristic of 2,4-D injury.

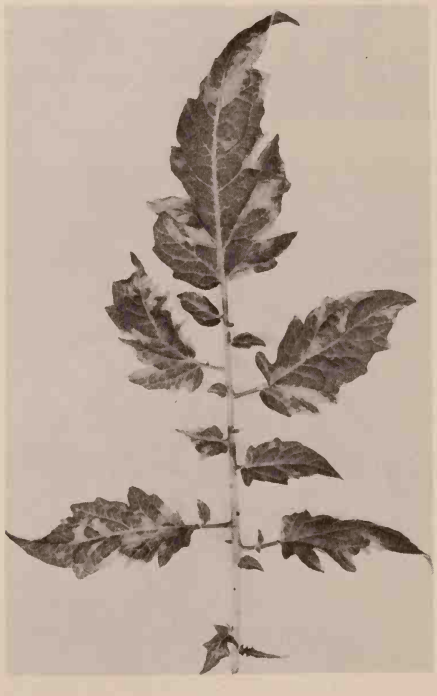

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Figure 15.–Tomato leaf showing mottling (yellow) caused by tobacco mosaic.

Gray Leaf Spot

Chico III*	Manapal
Floradel	Red Rock*
Florida MH-1*	Tropic
Manalucie	Walter

Late Blight

New Yorker	West Virginia 63

Bacterial Wilt

Saturn	Venus

Root Knot

Beefeater VFN	Nemared
Calmart*	VFN Bush*

Seed Treatment

To reduce losses from damping-off and other seed or seedling diseases, coat seed with a fungicide. Use dust of thiram, or dichlone at the rate recommended by the manufacturer.

PN-2367

Figure 16.—Root knot damage on tomato roots.

PN-3944

Figure 17.—Tomato plant showing bacterial wilt. Note rapid wilting of entire plant.

Place seed and dust in a tight container; put in no more than enough seed to half fill container. Shake the container 1 or 2 minutes to coat the seeds with dust. Then screen off the excess dust and plant the seed.

Applying Fungicides

Losses from leaf diseases and many fruit rots can be reduced by applying fungicide sprays or dusts. The fungicides mentioned in this bulletin are most effective when applied before the disease becomes established, and then at intervals thereafter. In those areas where these diseases are known to occur on an annual basis, applications of suitable fungicides should start when fruit forms on the first cluster, with later applications at 7 to 10 day intervals.

The precise amount of material to use depends on the formulated strength of the active ingredient, and on the kind of application equipment used. The intervals between applications are usually shortened during periods of high humidity or rainy weather. There is no need to apply a fungicide to control a disease that is not present in your area.

Names of Pesticides

Trade names are used in this publication to aid in identifying the proper pesticide. Mention of a trade name does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture or an endorsement by the Department over other products not mentioned.

It is essential to follow the directions on the label. The label directions include information on rates of application, intervals between sprays, limitations on the time of applications before harvest, residue tolerances, and safety precautions.

Crop Rotation

Crop rotation will not insure freedom from tomato diseases, but it will retard the buildup of disease organisms in the soil.

Do not grow tomatoes in the same soil more often than once every 3 years, or once every 4 years where bacterial wilt has been prevalent.

Eggplant, peppers, potatoes, and tobacco should not be grown for at least 4 years in any soil that has grown crops infected with bacterial wilt.

Do not plant tomatoes for at least 4 years where stem rot or southern blight has infected beans, beets, cabbage, celery, lettuce, peppers, potatoes, squash, sweetpotatoes, or watermelons.

Soil Fumigants

Disease organisms, nematodes, and weed seeds can be controlled in the soil by applying soil fumigants. The general soil fumigants control several kinds of organisms; others only one or various combinations. Fumigants are applied to the soil before planting seedbeds or before setting transplants in the field.

Row treatments with nematicides give satisfactory control of nematodes if infestation is light or spotty in the field. Otherwise, overall or solid treatment of the field gives best results.

Follow the manufacturer's instructions on the label for dosage and method of application because these vary, depending on soil type, formulation of the chemical, and method of application.

COMMON AND CHEMICAL NAMES OF FUNGICIDES FOR TOMATO DISEASE CONTROL

Common name	Chemical composition
Seed treatments:	
Dichlone	2,3-Dichloro-1,4-naphthoquinone.
Thiram	Bis(dimethylthiocarbamoyl) disulfide.
Fungicides:	
Chlorothalonil	Tetrachloroisophthalonitrile
Captafol	*cis-N*-[1,1,2,2-tetrachloroethyl) thio]-4-cyclohexene-1,2-dicarboximide
Fixed coppers	Basic copper sulfate, and copper oxychloridesulfate.
Maneb	Manganous ethylenebis (dithiocarbamate).
Zineb	Zinc ethylenebis (dithiocarbamate).

Active ingredients[a]	Other names
General soil fumigants:	
Methyl bromide (usually formulated with 2% chloropicrin).	MBr.
Trichloronitromethane	Tear gas, chloropicrin.
Methyl isothiocyanate + DD	DD-MENCS.
Sodium methyldithiocarbamate	SMDC, metham.
Nematicide soil fumigants:	
1,3-dichloropropene & 1,2-dichloropropane	DD.
1,3-dichloropropene	1,3-D.
Ethylene dibromide	EDB.
1,2-dibromo-3-chloropropane	DBCP.

[a]Mixture of these active ingredients are frequently manufactured.

PRECAUTIONS

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U.S. Environmental Protection Agency, consult your county agricultural agent or State Extension specialist to be sure the intended use is still registered.

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